Benthic Macroinvertebrate Indicators

Karen Blocksom

U.S. EPA-ORD-Cincinnati

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*Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy.

Why Collect Macroinvertebrates?

- Macroinvertebrates are ubiquitous and abundant in streams and rivers
- Relatively sedentary, so they are good integrators of local conditions
- Widely used across the U.S. in biomonitoring/bioassessment programs
- Provide an indicator which is consistent with the WSA and potentially other national EPA surveys

Field Collection Methods

- Methods currently in use vary widely across the U.S.
- Each sampling method incorporates numerous subcomponents
- Likely that parts of various methods will have to be combined into a method for this survey

Sampling Method Subcomponents

- Reach length
- Locations and numbers of samples within reach
- Types of samples (active or passive, gear type, substrate/habitat type(s))
- Mesh size
- Number of samples to be processed per site
- Laboratory subsampling and identification

Reach Length

- Options include multiples of wetted width and fixed length
- Multiples of wetted width:
  - Based on hydrogeomorphology, developed in wadeable streams
  - In larger systems, may result in reach lengths of several km
  - Reach may incorporate multiple inputs or disturbances
  - Problematic in anthropogenically modified systems
- Fixed length (what length?):
  - Based on research conducted in large rivers (500-1000 m)
  - Consistent effort across sites/rivers
  - Not based on characteristics of individual rivers

Locations and Numbers of Samples within Reach

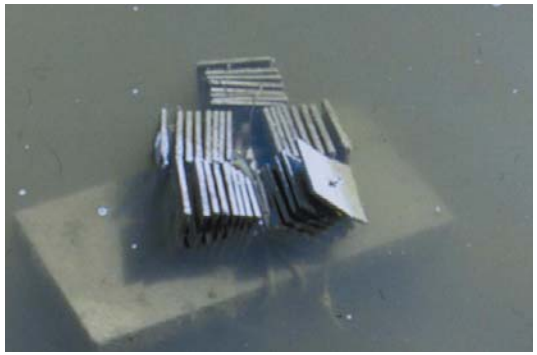
- Locations:
  - Transects systematically located along reach - little room for subjectivity, unbiased sampling of habitats within reach
  - Random locations – how to select locations
  - Richest targeted habitat – how to identify consistently across sampling crews
- Number of locations:
  - More locations better account for spatial variability
  - Require more time for sampling
  - May be limited by ability to move throughout reach

Types of Sampling within Reach

- Passive sampling:
  - Artificial substrates (e.g., Hester-Dendy multiplate, rock baskets)
  - Drift nets
- Active sampling:
  - Timed kicks
  - Multiple habitat sweeps/jabs (fixed number per habitat or proportional)
  - Snags
  - Dredge or bottom grab samplers (Ekman, Ponar, etc.)
- A combination of active and passive may be incorporated into a single method

Pros and Cons: Passive Sampling

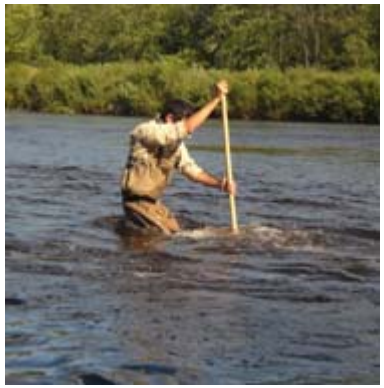
- Artificial substrates/rock baskets:
  - Consistent habitat for colonization across rivers and reaches
  - Require two visits to each site
  - High potential for loss of sampler



- Drift nets:
  - Do not sample effectively under some river conditions (e.g., high turbidity, high or very low flow)
  - Highly variable and dependent on season, time of day, water velocities, etc.

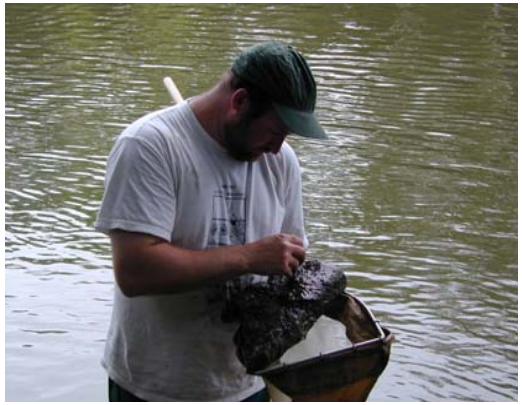
Pros and Cons: Active Sampling

- Kicks:
  - Effective in capturing many benthic taxa in nearshore or shallow areas
  - Random placement may incorporate microhabitats not detectable by humans
  - Can be difficult or unsafe to carry out in some systems and/or under certain conditions (i.e., terraced rivers, steep banks, higher flows)
  - Patchy distribution of organisms may result in more variability
  - Increased debris over artificial substrates increases processing time/effort



Pros and Cons: Active Sampling

- Multiple habitat sweeps/jabs:
  - May pick up habitats not captured in kick samples
  - Better representation of assemblage present at site
  - Determination of habitats to sample less consistent among crews
  - More variable due to differences in available habitats across sites and rivers
- Snags:
  - Consistent habitat type across sites
  - Can be sampled even in deep rivers from a boat
  - May not be available in all sites
  - Period of inundation or submersion unknown



Pros and Cons: Active Sampling

- Dredge/bottom grab:
  - Allows sampling in deep sites
  - Specifically designed for soft substrates
  - Quantitative, standardized sample
  - Difficult to deploy in higher flows or along complex banks
  - Debris may prevent proper operation of sampler
  - Patchy distribution of organisms may require a large number of grabs

Mesh Size

- Applies to both nets (if used) and sieves for collecting and processing samples
- 500 or 595/600 um used by many states
- Smaller sizes (~250 um) may do a better job of collecting certain types of taxa (i.e., oligochaetes)
- Larger sizes (i.e., ~800 um) result in less debris and clogging of net

Number of Samples per Site

- Typically only one sample per site for probability designs
- Additional samples at sites to estimate variability (~10% of sites for EMAP)
  - Same visit and reach – measures sampling error
  - Same visit, shifted reach – measures local spatial variation
  - Same reach, different visit – measures temporal variation (within year)
  - All options incorporate sampling error

Laboratory Processing and Identification: Subsampling

- Subsampling likely will be necessary due to amount of debris and number of organisms
- Laboratory offers more standardization in processing of sample
- Random subsample sorted:
  - Fixed proportion of sample or fixed number of organisms
  - Larger proportions or numbers of organisms provide better estimates
  - Beyond 500 organisms, little effect on metric values
  - Tradeoff for larger subsample is higher cost for potentially more information

Laboratory Processing and Identification: Taxonomy

- Taxonomic level of identification:
  - Consistent across all taxa (e.g., always to genus level)
  - Varying levels by taxonomic group (e.g., Oligochaetes to family, EPT to genus)
  - Lowest practical taxonomic level (e.g., depending on condition of specimen, keys available)
- Number of laboratories for processing:
  - Fewer labs means more consistency
  - More labs reduces time for sample analysis

Methods Used in WSA

- Reach length of 40X wetted width, minimum 150 m
- 11 transects with position in transect established randomly, proceed systematically
- Kick samples using D-frame net with 500 um mesh
- 1 composite sample per site, 10% of sites revisited
- 500 organism laboratory subsample
- Organisms identified to varying levels, depending on taxonomic group
- Several laboratories

Most Suitable Options for Rivers (based on goals and constraints)

- Active sampling approach (single visit)
- Fixed reach length with several sampling locations in reach
- 1 sample per site, with 10% revisits/duplicates
- Sampling approach that works in all habitat types
- 500-600 um mesh size for compatibility with wadeable assessments
- Fewer laboratories with subsampling in the laboratory